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*XXXII. Experiments and Observations on  
the Waters of Buxton and Matlock, in  
Derbyshire, by Thomas Percival, of Man-  
chester, M. D. and F. R. S.*

Read June 25, 1772.  
**T**HE water of saint Ann's-well is found, by analysis, to contain calcareous earth, fossil-alkali, and sea salts; but in very small proportions: for a gallon of the water, when evaporated, yields only twenty three, or twenty four grains of sediment. It strikes a light green colour with syrup of violets, suffers no change from an infusion of galls, from the fixed vegetable alkali, or from the mineral acids; becomes milky with the volatile alkali, and with Saccharum Saturni; and lets fall a precipitate on the addition of a few drops of a solution of silver, in the nitrous acid. The specific gravity of this water is precisely equal to that of rain water, when their temperatures are the same; but it weighs four grains in a pint lighter, when first taken from the spring. The heat of the bath is about 82 degrees of Fahrenheit's thermometer; that of Saint Ann's well, as it is a smaller body of water, and exposed to the open air, is somewhat less. The water is transparent, sparkling, and highly grateful to the palate \*

\* I am indebted to the information of the worthy physician who attends at Buxton, for some of these facts.

In October 1769, I passed a few days at Buxton ; and during my stay there amused myself with the following experiments on the effects of the water of Saint Ann's well, on my pulse.

### EXPERIMENT I.

October 12, eight o'clock in the morning. The day cold and moist, my pulse beat 84 strokes in a minute ; I drank at the well, the third of a pint of water, and, using every necessary precaution, examined my pulse at certain intervals of time ; in five minutes, pulse 80, in ten minutes pulse 80, fuller and harder ; in twenty minutes pulse 85 ; in half an hour pulse 90.

### EXPERIMENT II.

Eleven o'clock in the forenoon, two hours after breakfast, the air warm and serene, pulse 90 ; I repeated the draught of water. In seven minutes pulse 109 ; in fifteen minutes pulse 103 ; in thirty minutes pulse 100, head-ach ; in an hour and a half pulse 95, head-ach abated.

### EXPERIMENT III.

October 13, eight in the morning ; the day cold, pulse 92 ; I drank the quantity of water above-mentioned ; in five minutes pulse 86 ; in fifteen minutes pulse 86, full and hard ; in twenty minutes pulse 100 ; in half an hour pulse 92.

From the first and third experiments, it appears that the coldness of the morning counteracted for a time, the effects of the Buxton water ; and reduced the

the vibrations of my pulse from 84 to 80, and from 92 to 86. But the stimulus of the water soon became superior to the sedative powers of the cold to which I was exposed ; for within the space of half an hour my pulse rose to 90 in the first, and to 100 strokes in the second trial. At eleven o'clock before noon, when the air was warm and serene, the water in a much shorter time excited its force, increasing the velocity of my pulse from 90, to 109 vibrations in a minute. These experiments evince the heating quality of Buxton water, and suggest to us the precautions to be observed in the use of it. Small quantities should only be drunk at once, and frequently repeated ; the belly should be kept soluble with lenitive Electuary, or any other mild purgative and at the beginning of the course, the patient may be directed to suffer the water to remain a few seconds in the glass, before he swallows it. For this celebrated spring abounds with a mineral spirit, or mephitic air, in which its stimulus, and indeed its efficacy resides, and which is quickly dissipated by exposure to the air.

The honourable and ingenious Mr. Cavendish has shewn by his Experiments on Rathbone Place water, Ph. Transactions, vol. LVII, that calcareous earths may be rendered soluble in water, by furnishing them with more than their natural property of fixed air. And it has lately been discovered that iron also may be suspended by this principle, in the same menstruum \*. It appeared therefore highly probable to me, that a chalybeate impregnation might with great facility

\* Vid. Mr. Lane's experiments, Ph. Transactions, Vol. LIX.

be communicated to the Buxton water, when fresh drawn from the spring ; a quality, which in many cases would add greatly to its medicinal efficacy. I suggested the trial to Mr. Buxton, a very worthy and sensible apothecary near the wells, who has lately at my request made the following experiment.

#### EXPERIMENT IV.

A quart bottle containing two drachms of iron filings, was filled by immersion, with the water of Saint Anne's well, corked and agitated briskly under the surface of the water : it was then suffered to remain in the well till the filings had subsided, when the water was carefully decanted into a half pint glass ; to this were added three drops of the tincture of galls, which immediately occasioned a deep purple colour, and transparency was presently restored by a few drops of the acid of vitriol ; evident proofs that a solution of the iron was effected in a few minutes. The water also without the tincture of galls had a chalybeate taste, and left an agreeable astringency on the palate.

By this experiment, it appears that a warm chalybeate abounding with a mineral spirit, and grateful to the taste, may with very little trouble be obtained. And this method of impregnating the Buxton water with iron, must increase its tonic powers, and in many cases improve its medicinal virtues. It is a common practice to join the use of a chalybeate spring in the neighbourhood of St. Anne's well, with that of the Buxton water : but, the superiority of the artificial mineral water must be apparent, if we consider its agreeable warmth, volatility, levity, and gratefulness to the palate.

Buxton

Buxton bath is very frequently employed as a temperate cold bath. For as the heat of the water is about sixteen or eighteen degrees below that of the human body, a gentle shock is produced on the first immersion, the heart and arteries are made to contract more powerfully, and the whole system is braced and invigorated. But this salutary operation must be greatly diminished, often indeed more than counter-balanced, by the relaxing vapours which copiously exhale from the bath, to which the patients are exposed during the time of dressing and undressing. A separate room is indeed provided for the ladies; but the gentlemen have no other accommodations than what the vault affords in which the bath is contained, and are therefore liable to all the inconveniences arising from warmth and moisture.

## EXPERIMENTS ON MATLOCK WATER.

## EXPERIMENT I.

A thermometer made by Dollond, and graduated according to Fahrenheit's scale, was exposed for a sufficient length of time, to the steam of the water, as it gushes from the rock, and also immersed in the basin that receives it. The mercury rose to 66 degrees.

## EXPERIMENT II.

Six drops of Sp. Sal. Ammon. vol. were poured into a glass of the spring water, which contained N n n z about

about the sixth of a pint; a very slight cloudiness immediately ensued, but no precipitation was afterwards observable.

### EXPERIMENT III.

Six drops of a solution of salt of tartar occasioned a cloudiness, just perceptible, in the same quantity of water; no precipitation ensued.

### EXPERIMENT IV.

Six drops of a solution of saccharum saturni immediately produced a milkiness in the water, but no sensible precipitation.

### EXPERIMENT V.

Six drops of a solution of silver in the nitrous acid instantly occasioned a milkiness in the water; and after standing an hour, a grey powder was observable at the bottom of the glass.

### EXPERIMENT VI.

Ten drops of the infusion of galls neither produced any change of colour in the water at the time they were added, nor was the slightest purple hue perceptible two hours afterwards.

### EXPERIMENT VII.

A piece of paper besmeared with syrup of violets was dipped into a glass full of water; no change of colour ensued.

## E X P E R I M E N T VIII.

Another piece of paper, moistened in the same manner with the syrup, was placed over a glass of water, as soon as it was taken from the spring. The paper suffered no change of colour, although it remained an hour upon the glass.

## E X P R I M E N T IX.

My pulse beat 84 strokes in a minute, at the time when I drank a half pint glass of the Matlock water; in 20 minutes my pulse rose to 86; in half an hour after they sunk to 82, and continued to vibrate the same number of times for an hour, which was as long as I thought it was necessary to examine them.

## E X P E R I M E N T X..

The mercury in the thermometer, when immersed in each of the baths, stood at 68: in the river Derwent, which flows through the valley of Matlock, at 52. These experiments were made in the month of June 1772, and the weather was warm..

## E X P E R I M E N T XI.

A four ounce phial, after being accurately counterpoised in a very nice balance, was filled to the brim with distilled water, which weighed three ounces, four drachms, forty five grains and a half. The same phial, exactly balanced as before, was then filled to the brim with Matlock water, of the same temperature

perature with the distilled water, which weighed three ounces, four drachms, and forty six grains.

Matlock water is grateful to the palate, and of an agreeable temperature, but exhibits no marks of any mineral spirit, either by its taste, sparkling appearance in the glass, or by the chemical test employed in experiment 8. The second and third experiments shew that it is very slightly impregnated with Selenites or other earthly salts ; and of this its comparative levity affords also a further proof : for it weighs twenty-six grains in a pint lighter than the Manchester pump water\*, and only four grains heavier than distilled water. The precipitation of a grey powder, by the adding of a solution of silver in aqua fortis to the water, renders it probable that a small portion of sea salt is contained in it. For the powder is found to consist of the particles of silver, combined with the muriatic acid, which is separated from the fossil alkali by the superior affinity the nitrous acid bears to it ; and thus a double elective attraction takes place in this experiment.

This water is said to contain iron, but the assertion is at least rendered doubtful by the 6th experiment, which was made with the utmost accuracy ; and I am inclined to think, that it is entirely without foundation. The spring is justly celebrated for its efficacy in hæmoptoës ; and hence it may have been too hastily concluded that it possesses some slight degree of stypticity, by means of a chalybeate impregnation.

\* Vid. the author's treatise on the pump water of Manchester. Essays medical and experimental, p. 207. 2d edit.

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The 9th experiment, which my short stay at Matlock would not allow me leisure to repeat, affords a presumption that the water is not possessed of any stimulating powers; for the small increase of quickness in my pulse, on drinking half a pint of it, may be ascribed more to the quantity received into the stomach, than to the heating quality of the water,

The Bristol and Matlock waters appear to resemble each other, both in their chemical and medicinal qualities. I have examined and compared them together by the test mentioned above, and so far as such trials may be deemed conclusive, there seems to be no other than the following slight difference between them,

Bristol water becomes a little more milky on the addition of a solution of fixed alkali, and of Saccharum Saturni than that of Matlock; the former also weighs near a grain in a pint heavier than the latter. Is it not to be lamented therefore, that so little attention is paid to Matlock, even by the physicians who reside in the neighbourhood of it? In hectic cases, hæmoptoe, the diabetes, and other disorders, in which the circulation of the blood is rapid and irregular, I should apprehend that Matlock water, on some accounts, claims the preference to that of Bristol; for it is less disposed to quicken the pulse, and may therefore be drunk in larger quantities. But it must be acknowledged that the climate of Bristol is superior to that of Matlock, a circumstance of the highest importance to consumptive patients. Situated in a deep though delightful valley, and surrounded by very high mountains, the sun disappears

at Matlock earlier in the evenings, the fogs are longer in dispersing, and it may be presumed that rain falls here more frequently and copiously than in other places. For at Catsworth, which is encompassed also with hills, and is about ten miles distant, in 1764, 1765, 1767, and 1768, about 33 inches of rain fell at a medium each year.

The following table exhibits a comparative view of the different temperatures of Bath, Buxton, Bristol, and Matlock waters, measured by Fahrenheit's thermometer.

<b>* B A T H.</b>	
King's Bath Pump	112 °
Hot Bath Pump	114 $\frac{1}{2}$
Cross Bath Pump	110
<b>* B R I S T O L.</b>	
Hot Well Pump	76
<b>B U X T O N.</b>	
Bath	82
St. Ann's Well	81 ×
<b>M A T L O C K.</b>	
Baths	68
Spring	66

\* Vid. Mr. Canton's experiments. Ph. Transf. Vol. LVII.  
p. 203.